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The attached document contains comments to the FAA Docket No. FAA-1999-5535;
Notice No. 99-04, Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations. These comments are provided by Applied Science &Technology Inc. (ASTi) and represent ASTi's views based upon our experience as flight crew and rocket system launch operators within the federal government. Any questions regarding the attached comments can be addressed to Mr. Ron Schena of ASTi at 505-846-5928, or e-mail: schenar@plk.af.mil. <<FAA RLV NPRM COMMENTS.doc>>

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Comments to FAA NPRM: Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations
Docket Number: FAA- 1999-5535; Notice No. 99-04

The following comments are based on the Draft FAA NPRM identified by the number [4910- 13] on Page 1, and consists of 169 pages of double spaced text. All page references are to this particular version.

General comment: In making the comments below the NPRM was reviewed with the overall goal of developing a regulatory environment that would be streamlined and flexible for the emerging RLV industry. Personal flight crew and RLV test vehicle experience was used in the generation of these comments. But again the primary, and stated by FAA/AST, emphasis of this effort is to develop a regulatory regime that is not overly restrictive and will evolve with the RLV industry.

1. Page 23, paragraph beginning "That said,. . .": Is the combining of launch and recovery operations being considered for a mission license? It seems that the FAA could use the aircraft model more in this area whereby an operator would be licensed to operate their vehicles and would be required to file a flight plan that included the takeoff (launch) and landing (reentry and landing) scheduled times, etc.

2. Page 26, Paragraph beginning "Except for extended . . .": It appears that this paragraph is intended to be all-encompassing for RLVs, however, such other uses of reusable vehicles for lunar or interplanetary type missions are not covered.

3. Page 27, Paragraph beginning "The FAA also considered . , .", mid-paragraph: This paragraph does not appear to consider reusable upper stages for the definition of where FAA licensed activity ends.

4. Page 29, top of page, sentence beginning "Accordingly, the FAA . . .": This sentence does not appear to consider reusable upper stages that retain the payloads.

5. Page 32, first paragraph, last sentence: The FAA should include a regulatory growth path to the future when E sub c may not be used as a determining factor, such as when the industry and individual systems have a reliability track record.

6. Page 33, top of page, last sentence: Include with the crew, as being mission essential and not a part of the general public, all ground crew and other support personnel. Also, how would passengers on a future RLV passenger flight be treated, as mission essential or general public?

7. Page 33, discussion on E sub c: If the FAA is planning on using E sub c as the safety determinant then all factors that impact an accurate E sub c calculation must be included, such as lethal debris impact size, what percentage of population is at risk at any given time of the day, the size of a person, and the like.

8. Page 37, bottom of page, sentence beginning "Accordingly, the FAA . . .": In any discussion about the standard used by Federal Ranges for risk criteria the full discussion of what is included in the definition and calculation of those risk criteria must be included. See Range Commanders Council, Standard 32 l-97, Common Risk Criteria for National Test Ranges.

9. Page 38, Paragraph beginning "Failure modes and . . .": The entire premise of using a probability of failure (P sub f) of 1 .O (it fails every time) in risk analyses is overly conservative (to put it mildly). RLV developing contractors should be able to determine, by analysis (as is the entire E sub c determination) a less conservative or more realistic P sub f for their system at various points along its flight path of concern to the FAA. A P sub f of 1 .O would potentially skew the data and E sub c calculations such that no one could be licensed.

10. Page 43, second complete paragraph: How does the FAA define "sufficient data", here and in other areas of this document? There is a potential for such a term requiring "open ended" data submissions.

11. Page 44, second complete paragraph: How does FAA define "substantial dwell time"? And in the definition is it different within and outside the confines of a "spaceport"?

12. Page 45, top of page, sentence beginning "For example, dwell time...": At this particular point in an RLV's flight path it will mostly likely be traveling vertically, or near vertically, and its IIP potentially would remain within the confines of a spaceport. (see 11. Above).

13. Page 46, second complete paragraph: In the flight test discussion of ELVs versus RLVs it should also be stated that the FAA won't impose ELV requirements upon RLVs. These vehicles are not aircraft, in the classic definition, but neither are they ELVs, somehow the entire community – regulatory, development and operations – must define the "happy medium" somewhere between ELV and aircraft.

14. Page 47, Paragraph B.: The monitoring of flight and safety critical systems should also be accomplished while on-orbit for those systems that operate on orbit also.

15. Page 48, Paragraph C.: If the FAA required an operator to file a "spaceflight plan" with specific takeoff (launch) and reentry times some of the concerns raised in this paragraph have the potential for being alleviated.

16. Page 50, first complete paragraph: The "target" terminology used in the analogy is inappropriate for RLVs, it gives the wrong impression.

17. Page 52, first paragraph: The location, size and design configuration of a launch site (spaceport) should not be the responsibility of the RLV operator, unless the RLV operator is also the spaceport operator. This information should be provided by the RLV operator for information only as part of the licensing process.

18. Page 52, third paragraph, sentence beginning "However, many reentry . . .": Add the words "and performing" between ". . . of attempting" and ". . .a nondestructive abort." To be more complete.

19. Page 53, first paragraph, last sentence: What is the FAA's position regarding human intervention before a vehicle would be allowed to operate within controlled airspace? This paragraph just leaves the reader hanging with no clear indication of which way the FAA may come down on this topic.

20. Page 56 – 57, mission approach to licensing discussion: The FAA should consider a definition of a mission as all the activities beginning with takeoff, orbital insertion, on-orbit activities, reentry and landing. Takeoff itself could include the actual launch, staging for multiple stage RLVs and the recovery of reusable stages. On orbit operations would include delivery of payloads to their initial orbit and/or operations conducted by a reusable upper stage while on orbit. Reentry would include the deorbit maneuvers, actual reentry into the atmosphere, up to atmospheric operations leading to approach and landing.

2 1. Page 68, last paragraph: Does the FAA feel that the dress rehearsals noted in this paragraph will be a continuous requirement, or a requirement that will eventually be removed as both individual operators and the industry matures? As it's stated in this section the requirement is very much ELV-like and not aircraft-like and would add to operator's costs, etc. As the industry and individual systems mature "dress rehearsals" could migrate into more of training for flight and ground crews.

22. Page 70 and 71, Section 43 1.35: Why are there two different E sub c values for launch and reentry? If a mission, as stated in the NPRM earlier, includes both the launch and reentry activities they should be the same. Also does this section imply that there will always be a separate and distinct landing site from the takeoff site?

23. Page 7 1 and 72, last paragraph: How is the 100 mile area surrounding a reentry site computed? It is not clear here and could be greatly different areas depending upon how it's computed. Also, for COMET/METEOR was the reentry vehicle remotely controlled or autonomously controlled, or was

purely ballistic reentry? Landing area requirements for controlled, remotely, autonomous or piloted, should be much smaller than for a ballistic system.

24. Page 75, paragraph ending on top of page, last sentence: It was shown during the DC-X flight test series that "intervention" by a remote operator can safely recover an autonomous vehicle during an emergency. That option should be allowable under this rule.

25. Page 76, last paragraph: I believe that the E sub c criteria of 30 casualties in a million is for a million people, not a million missions. Aircraft could not meet this requirement.

26. Page 77, last paragraph, crew rest: AST could take a lesson from the aircraft side, civil and or military, on determining crew rest requirements for ground and flight crew. For example: long duration missions, greater than one day, an "augmented flight crew" duty day could be instituted, 12 hours for 3 or 2 shifts with overlap of crews to "pass the baton", and 16 hour duty days for short duration missions.

27. Page 80, Section 43 1.55: Does this section apply to all payloads, including those that remain internal to an RLV? General comment on the entire payload area: as its currently written hopefully it will not preclude changes in the future for more aircraft-like cargo, payload and passenger operations.

28. Page 85, Section 43 1.79: Couldn't this section be simpler and less time consuming and expensive for an RLV operator if you set this up similar to an aircraft flight plan – Spaceflight plan? During early flight testing, or the very early stages of the industry, this level of report could possibly be necessary, but it should become much less burdensome as the industry and/or individual systems mature.

29. Page 86, Section 43 1.85, Subpart F: Are aircraft developers or operators required to comply with a similar environmental requirement? This should be the responsibility of a licensed spaceport operator and the EA/EIS for a spaceport should be a "blanket" one and any special, different systems not covered could then be tiered off the overall EA/EIS.

30. Page 87, Part 433: A reentry could also be an integral part of a launch site/spaceport. This section should consider that option.

3 1. Page 97 and 98, Industry Compliance Costs: All the costs computed by AST for commercial operators appear extremely low and based on very low hourly cost (fully burdened) values. For example, the hourly rate used by AST to compute these values equates to $50 per hour, where a mid-level engineer's fully burdened rate is more on the order of $80 to $100 per hour. Also the amount of time to complete paperwork requirements appears unreasonably low – 8 hours.

32. Page 105 and 106, Section 43 1.93: The cost for an RLV operator to comply with environmental regulations is very low if this is intended as an EA/EIS. If it is additional information for a tiered EA for a specific new system, then it may be reasonable.

33. Page 108, paragraph titled "benefits": The discussion centers around expected average casualties as an E sub c against a million missions. In reading the Range Commanders Council (RCC) Standard 32 1-97: Common Risk Criteria for Test Ranges, which appears to be the National Range standard referred to throughout the NPRM, the risk criteria is measured against a million people: i.e. one person in a million at risk of casualty. The NPRM should reflect this definition of E sub c rather than per million missions as is done now. This should be applied throughout the document.

34. Page 109, subparagraphs (1) and (2): Why are the criteria in these two subparagraphs different? If the public adjacent to a reentry site are outside the confines of the reentry site/spaceport then the criteria in (1) should apply for general public.

35. Page 110, top of page, sentence beginning "(Third), probabilities.. .": Define what percentage of landmass is. That would clarify the discussion.

36. Page 110, paragraph beginning "And last, expected.. .": There is in fact some historical RLV accident history from the McDonnell Douglas DC-X/XA flight test program. Granted this system did not fly to space and reenter, but it did perform emergency flight procedures and ended with a destructive landing accident. Also at the bottom of the page, how did the FAA estimate the expected casualty and property loss values? Knowing that information would help the discussion and understanding of what may be expected of a contractor applying for an operator's license.

37. Page 111, paragraph beginning "Safety benefits - . . .": If these calculations were performed using the assumptions put forward earlier then the totals computed are 1.75 to 2.0 times too low.

38. Page 115, first paragraph: The figure of $50 million used for average expected revenue per mission for RLVs appears to be very high. How was it determined? If it was done by a poll of RLV developers then that would be acceptable.

39. Page 123, paragraphs entitled "Operation of a launch site" and "Operation of a reentry site": These definitions only indicate that "operation" means only the "conduct of approved safety operations". This is a very incomplete definition of "operation of a site". Either the titles need to be changed to reflect the limited definition or the definition needs to be changed to be more complete.

40. Page 134, Section 43 1.7: This section does not consider a potential payload option available with RLV systems – that is payloads that are carried aboard an RLV and remain within the RLV, perform their assigned mission on orbit and reenter with the RLV. This could also apply to payloads picked up on orbit and returned to earth.

41 Page 138, Section 43 1.3 1: Is the FAA staffed to conduct these safety reviews? Is this type of review only for application purposes or will it be required as the operator proceeds into routine operations also? Will this be similar to aircraft operator certification procedures?

42 Page 140, subparagraphs (1) and (2): For initial test flights to define a flight envelope and prove the operability of an RLV, dress rehearsals may be in order. However, as a system matures, that requirement should be reduced to a recurring training requirement for the crews similar to aircrew simulator training. A flight crew on a commercial airliner currently does not have to "rehearse" their entire flight before each flight, a mature RLV industry should not required to follow ELV procedures. See also item 21 above.

43. Page 144, Section 43 1.4 1, subparagraph (a): If "safety operations personnel" includes flight crew, be they on the RLV or controlling it from the ground, there is no problem. However, as it reads the safety operations personnel appears to assume all the responsibilities for flight and mission success that a "pilot in command" would.

44. Page 157, Section 43 1.79: This section should be changed to be more in keeping with "aircraft-like" operations instead of saddling RLV operators with ELV style requirements. See also item 29 above.